

## REMARKS

### Introduction

This application has been reviewed in light of the Office Action dated January 31, 2003. Claims 1-16 are in the application; claims 11-16 were previously withdrawn from consideration as directed to a non-elected invention. Claims 1-3, 5-7, 9 and 10 are now presented for examination. Claims 4 and 8 have been cancelled without prejudice. Claim 1 has been amended to more particularly point out and distinctly claim the subject matter regarded as the invention. Claim 1 and claim 11 (withdrawn) are independent. Favorable review is respectfully requested.

### Scope of Amended Claims

It will be immediately apparent that the subject matter of claim 4 has been incorporated into claim 1. Accordingly, the scope of claim 1, the broadest claim now presented, is the same as that of claim 4 previously considered by the Examiner. It therefore is respectfully submitted that this amendment does not raise any new issues with regard to the patentability of the claims.

### Rejection under 35 U.S.C. § 102(b)

Claims 1, 4, 5 and 8 were rejected under 35 U.S.C. § 102(b) as anticipated by Colgan et al. (U.S. Pat. No. 5,565,707). Claims 4 and 8 have been cancelled, thereby rendering the rejection of those claims moot. The applicants respectfully submit that amended independent claim 1 is patentably distinct from the cited art, for the following reasons.

The present invention, as defined in claim 1, is directed to an integrated circuit including a patterned copper layer, a patterned aluminum layer, and a stud connection. The stud connection is in an opening in a layer of material between a location on the patterned copper layer and a location on the patterned aluminum layer; the stud connection is formed of tungsten. The circuit also includes a liner in the opening, extending between the stud connection and the location on the patterned copper layer.

It is thus a feature of the present invention that (1) the stud and the liner are located in an opening in a layer of material between the patterned aluminum and copper layers, and (2) the stud is formed of tungsten.

Colgan et al. describes an interconnect structure in which two patterned metal layers 30, 40 are separated by an insulation layer 34, with an opening 36 therein having an interlayer contact or stud 12 (Colgan et al. Figure 1). The patterned metal layers of Colgan et al. may be aluminum, copper or alloys thereof (col. 4, lines 38-41; col. 5, lines 3-6). Colgan et al. specifically teaches that the contact between the two layers (that is, the stud 12) is formed of  $\text{Al}_2\text{Cu}$  in the theta phase (col. 4, lines 9-10). This is in contrast to the present invention, where the stud connection is explicitly recited as being formed of tungsten. Colgan et al. thus does not disclose or suggest a stud connection as in the present invention.

The Examiner points to Colgan et al., col. 2, lines 65-66, as disclosing a tungsten stud connection. The applicants wish to point out that this tungsten stud connects to a silicon device, as opposed to connecting an aluminum patterned layer with a copper patterned layer. Similarly, Colgan et al. describes openings in an insulation layer 22, through which tungsten metal contacts may be formed to connect to semiconductor devices (col. 4, lines 21-27). One following the teaching of Colgan et al. would thus provide a tungsten contact to a device layer, but would provide an  $\text{Al}_2\text{Cu}$  contact between two patterned metal layers.

Accordingly, the structure of the present invention (specifically, a stud connection formed of tungsten between the patterned copper layer and the patterned aluminum layer) is not disclosed or suggested in Colgan et al., so that the present invention is neither anticipated nor made obvious by that reference.

#### Rejections under 35 U.S.C. § 103(a)

Claims 2 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Colgan et al. in view of Barth et al. (U.S. Pat. Appln. Pub. No. 2002/0102809). Barth et al. is understood to disclose a method of making a MIM capacitor, in which an opening is formed in a dielectric layer 214, and the opening is filled with a liner and conductive material 242 (para. 48-50; Figure 10). According to Barth et al., the conductive material in the opening is preferably a copper alloy (para. 50). This is in contrast to the present invention, where the stud connection in the opening is formed of tungsten. Barth et al. therefore does not remedy the above-noted defects of Colgan et al. as a reference against the present invention.

A combination of Colgan et al. and Barth et al. would at best yield an arrangement where an opening is formed in a dielectric layer; the opening is lined with tantalum or a metal nitride; and a conductive layer of copper or a copper alloy is formed in the opening. Neither Colgan et al. nor Barth et al., or a combination thereof, suggest a stud connection as in the present invention. Accordingly, the invention defined by dependent claims 2 and 6 would not have been obvious from the cited references.

Claims 3 and 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Colgan et al. in view of Tobben et al. (U.S. Pat. No. 6,261,950). As noted by the Examiner, Tobben et al. suggests a liner material of titanium or titanium nitride. Tobben et al. does not disclose or suggest a stud connection formed of tungsten, as in the present invention. In contrast to the present invention, Tobben et al. teaches filling a via with Al, Cu or alloys thereof (col. 4, lines 8-11 and 60-63; col. 6, lines 2-3). A combination of Colgan et al. with Tobben et al. would at best yield an arrangement where an opening in an insulating layer has a liner as suggested by Tobben et al. and is filled with an Al-Cu alloy to form a stud connection. The present invention, as defined by dependent claims 3 and 7, would therefore not have been obvious from Tobben et al., considered either alone or in combination with Colgan et al.

Claims 9 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Colgan et al. in view of Jain et al. (U.S. Pat. No. 6,417,092). Jain et al. is understood to disclose a method of forming an etch stop layer for use with an insulating layer. Jain et al. does not teach or suggest a stud connection formed of tungsten between a patterned copper layer and a patterned aluminum layer, as in the present invention; Jain et al. merely mentions that metal interconnects are typically copper (col. 1, lines 31-34). Accordingly, Jain et al. does not remedy the above-noted defects of Colgan et al. as a reference against the present invention. The present invention, as defined in claims 9 and 10, would thus not have been obvious from Jain et al., considered either alone or in combination with Colgan et al.

The other claims in this application are each dependent from the independent claim discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

### Finality of Rejection

The Examiner stated that the amendment previously presented in claim 1 (in the Amendment under 37 C.F.R. § 1.111 filed November 14, 2002) necessitated the new grounds of rejection. This statement is respectfully traversed for the following reasons.

(1) The amendment presented in claim 1 changed the recitation “a stud connection in an opening between a location on said patterned copper layer and a location on said patterned aluminum layer” to –a stud connection in an opening in a layer of material between a location on said patterned copper layer and a location on said patterned aluminum layer–. The phrase –in a layer of material– was added to specify that the opening is in a layer, which is between the two recited locations, as opposed to merely the opening being between the two locations. This amendment was consistent with the well-known practice of not claiming an opening by itself, but by reference to the material in which the opening is formed (“Holes are nothing; you cannot claim nothing.” R.C. Faber, Landis on Mechanics of Patent Claim Drafting, 3rd ed., § 26.). It is not understood how this claim change could have made a new ground of rejection necessary.

(2) Claims 4, 5 and 8 were rejected over newly cited Colgan et al., even though no amendment to those claims was ever presented. A final rejection under these circumstances is improper. MPEP § 706.07(a).

(3) Furthermore, a second action should not be made final if it includes a rejection, on art not of record, of any claim amended to include limitations which should reasonably have been expected to be claimed. MPEP § 706.07(a). As noted above, the addition of the phrase –in a layer of material– in claim 1 was made to satisfy a formal requirement of claim language, and could reasonably have been expected in view of claim-drafting practice.

Accordingly, withdrawal of the finality of the present Office Action is respectfully requested.

### Conclusion

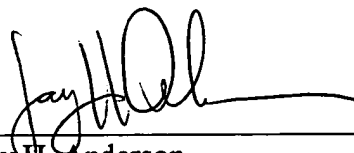
In view of the foregoing amendments and remarks, the applicants respectfully request favorable consideration and early passage to issue of the present application.

It is respectfully noted that this response to the final Office Action is being filed within two months of the mailing date thereof. Accordingly, in the event an advisory action is not mailed until after the three-month shortened statutory period for reply to the Office Action, said statutory period will not expire until after the date the advisory action is mailed.

MPEP § 714.13.

The applicants' undersigned attorney may be reached by telephone at (845) 894-3667. Correspondence relating to this Amendment should be directed to the below listed address.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Jay H. Anderson", written over a horizontal line.

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